

REMARKS

Applicant thanks the Examiner for acknowledging Applicant's claim to foreign priority under 35 U.S.C. § 119(a)-(d), and for confirming that the certified copy of the priority document has been received at the Patent Office.

Drawings:

Applicant thanks the Examiner for indicating that the drawings filed on August 16, 2004 have been approved.

Claim Objections:

The Examiner has objected to claim 3 because of a informality in the claim, and requested changing "y" to "y' ". As shown in the previous section, Applicant has adopted the Examiner's suggestion.

However, Applicant notes that it is not intended that the relationship " $0.75 \leq x/y' \leq 1$ " set forth in claim 3 is not an additional limitation to the original relationship " $0.75 \leq x/y \leq 1$ " set forth in claim 1, but is instead intended to replace the original relationship. Applicant notes that in original claim 3, the definition of "y" (now "y' ") was intended to alter the definition of "y" in claim 1, and not add a secondary limitation.

Further, Applicant notes that the above referenced claim amendment has been made to merely clarify the claimed invention and are not intended to narrow the original scope or spirit of the claims in any way.

Claim Amendment:

Applicant further notes that claim 1 has been amended to further clarify the present invention. Applicant submits that support for the amendment to claim 1 can be found in at least pages 12-13 of the present application.

Claim Rejections:

Claims 1-6 are all of the claims that have been examined in the present application, and currently all of these claims stand rejected.

35 U.S.C. § 103(a) Rejection - Claims 1, 2, 4 and 5:

Claims 1, 2, 4 and 5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the previously applied Shimada reference in view of Japanese Reference # JP 04-257446 to Mukoyama. In view of the following discussion, Applicant respectfully traverses the above rejection.

In rejecting the above claims, the Examiner acknowledges that Shimada fails to teach or suggest each and every feature of the claimed invention. To cure this deficiency, the Examiner is relying on the Mukoyama reference. However, Applicant submits that even if it would have been obvious to combine the references as suggested by the Examiner (although Applicant does not admit this), the resultant combination would not teach or suggest each and every feature of the claimed invention.

Turning now to the Examiner's rejection, as previously noted Shimada discloses a structure in which a lower electrode is formed on a region smaller than the width of a pressure generating chamber. Namely, the width of a piezoelectric layer formed on the lower electrode is

about half (50%) that of the pressure generating chamber. This is contrary to the present invention.

Further, Mukoyama discloses a print head where the ratio of the width of a piezoelectric element to that of a pressure generating chamber is within a range 0.8 to 1. However, this teaching, taken together with Shimada, still fails to teach each and every feature of the claimed invention.

In the present invention, both ends of a piezoelectric layer, in its width direction at a pressure generating chamber side, are positioned in a region facing the pressure generating chamber, and a relationship between a width "x" of a portion of the piezoelectric layer provided on a lower electrode (the portion of the piezoelectric layer being located facing the lower electrode at the pressure generating chamber side) and a width "y" of the pressure generating chamber at a vibration plate side satisfies $0.75 \leq x/y \leq 1$. Additionally, the piezoelectric layer has, when cut along its width direction, a substantially trapezoidal cross section as shown in Fig. 3 of the present application. The width "x" of the piezoelectric layer at the pressure generating chamber side is defined by both ends, in a width direction, of the bottom of the piezoelectric layer. Moreover, since a piezoelectric active portion is made up of a portion of the piezoelectric layer sandwiched between the upper and lower electrodes, both ends of the piezoelectric layer, at the pressure generating chamber side, do not constitute the piezoelectric active portion of the piezoelectric element.

The deficiencies of the Shimada reference are not cured by Mukoyama, because Mukoyama only defines the ratio of the width of the "the piezoelectric active portion" to that of

the pressure generating chamber, and not the width of the of a portion of the piezoelectric layer provided on a lower electrode, when the piezoelectric layer has a substantially trapezoidal shape.

Because of this, when (and if) attempting to combine these references, a skilled artisan might create a structure in which the ratio of the width of the piezoelectric active portion of the piezoelectric layer (shown in Shimada), which is sandwiched between the upper and lower electrodes, to that of the pressure generating chamber within a range 0.8 to 1. However, this teaching does not expressly teach the claimed invention.

By contrast, the present invention defines the ratio of the width of the piezoelectric layer “formed on the lower electrode at the pressure chamber side” to that of the pressure generating chamber, rather than defining the ratio of the width of the piezoelectric active portion to that of the pressure generating chamber.

Applicant submits that the present invention is different from those where the ratio of the width of the piezoelectric active portion to that of the pressure generating chamber is defined within a predetermined range.

It is for at least this reason that Applicant submits the present claims are allowable.

However, additionally and independently, Shimada discloses a structure in which the piezoelectric layer has a trapezoidal cross section. However, unlike the present invention, a lower electrode is not formed under both ends, in the width direction, of the piezoelectric layer. By contrast, the claimed invention has a lower electrode formed under both ends in the width direction of the piezoelectric layer. This deficiency is not cured by the Mukoyama reference.

Therefore, the structure of both Shimada and Mukoyama are different from the structure of the claimed invention, where the piezoelectric layer formed on the lower electrode has a trapezoidal cross section.

Thus, in addition to the previous discussion, Applicant submits that for this additional reason, the combination of the above references fails to teach or suggest each and every feature of the claimed invention.

Finally, because of the above discussed aspects of the claimed invention, the rigidity of the vibration plate increases and it is possible to suppress an increase in an initial displacement amount of the vibration plate, that is typically caused by residual strain generated in the piezoelectric element as a result of repeated driving of the piezoelectric element. Namely, this benefit is achieved by, providing a structure where the lower electrode is provided to extend from an area facing the pressure generating chamber to an area facing compartment walls which are present on both sides of the pressure generating chamber, and where the ratio of the width of the piezoelectric layer formed on this lower electrode at the pressure generating chamber side to that of the pressure generating chamber at the piezoelectric element side is set to satisfy the claimed range. This benefit can not be achieved or gleaned from the cited prior art, as they fail to disclose or suggest this aspect of the claimed invention. Further discussion of this can be found on at least pages 13 and 14, of the present application.

As described above, the present invention contains a structure in which the piezoelectric layer formed on the lower electrode has a trapezoidal cross section, and satisfies the relationship where the width “x” (defined by both ends in the width direction of the piezoelectric layer at the pressure generating chamber side), and the width “y” of the pressure generating chamber (at the

piezoelectric element side) satisfies $0.75 \leq x/y \leq 1$. By satisfying this aspect of the invention, the vibration plate due to the driving of the piezoelectric element can be reduced.

In view of the foregoing, Applicant respectfully submits that one of ordinary skill in the art would not have been motivated to combine the above references as suggested by the Examiner, and even if one combined the references as suggested the resultant combination would fail to disclose, teach or suggest each and every feature of the claimed invention. Therefore, Applicant submits that the Examiner has failed to establish a *prima facie* case of obviousness with respect to the claimed invention, as required under 35 U.S.C. § 103(a). Accordingly, Applicant hereby requests the Examiner reconsider and withdraw the above 35 U.S.C. § 103(a) rejection of the claims.

35 U.S.C. § 103(a) Rejection - Claims 1-6:

Claims 1-6 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,712,456 to Matsuzawa et al. in view of Mukoyama. In view of the following discussion, Applicant respectfully traverses the above rejection.

Matsuzawa discloses a structure in which a pressure generating chamber has a space portion, at the piezoelectric element side, and is formed so that the pressure generating chamber has a width smaller than that of the piezoelectric element (piezoelectric layer). This is shown in at least Figures 4A to 8B.

Because of this configuration, the width of the piezoelectric layer is wider than the pressure generating chamber. Accordingly, Matsuzawa is different from the invention claimed in the present application where the relationship between the width “x” of the piezoelectric layer

formed on the lower electrode at the pressure generating chamber side and the width “y” of the pressure generating chamber is $0.75 \leq x/y \leq 1$.

Additionally and independently, neither of the references disclose a cross section of the piezoelectric layer, when cut along the width direction, which has a trapezoidal shape, as set forth in the claims.

Finally, because of at least the above described deficiencies, Applicant submits that the combination of the above references would fail to teach or suggest the claimed invention, and achieve the benefits of the present invention, discussed above regarding the Shimada reference.

In view of the foregoing, Applicant respectfully submits that one of ordinary skill in the art would not have been motivated to combine the above references as suggested by the Examiner, and even if one combined the references as suggested the resultant combination would fail to disclose, teach or suggest each and every feature of the claimed invention. Therefore, Applicant submits that the Examiner has failed to establish a *prima facie* case of obviousness with respect to the claimed invention, as required under 35 U.S.C. § 103(a). Accordingly, Applicant hereby requests the Examiner reconsider and withdraw the above 35 U.S.C. § 103(a) rejection of the claims.

Conclusion:

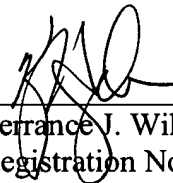
In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

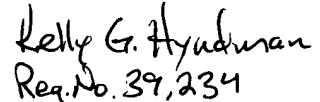
AMENDMENT UNDER 37 C.F.R. §1.116
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Respectfully submitted,


Terrance J. Wikberg
Registration No. 47,177


Kelly G. Hyndman
Reg. No. 39,234

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

WASHINGTON OFFICE

23373

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